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The Face Mask-Touching Behavior During the COVID-19 Pandemic: Observational Study of Public Transportation Users in The Greater Paris Region: The French-Mask-Touch Study

running title: *mask touching in public transportation*

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1

2 **Abstract**

3 **Background:** To limit the spread of the new coronavirus disease 2019 (COVID-19), the
4 World Health Organization recommends the use of face mask as a part of the pandemic
5 control strategy. It has published also “best practices” in which it advises to avoid touching
6 the mask while wearing it. This might be challenging. The purpose of this study was to
7 investigate the frequency of mask-touching behavior in public transportation.

8 **Methods:** Observational study using data collected in real life. This survey was conducted in
9 subways and local trains of the greater Paris region, France, between May 4th and 25th, 2020.
10 Public Transportation users were covertly observed. Demographic characteristics, type of
11 mask and the main activity were collected by the investigator. The duration of observation,
12 the frequency of touching face mask, hair and the uncovered area of the face were also
13 recorded. Frequency of mask-touching per hour was determined.

14 **Results:** One hundred eighty two persons were observed. The median of estimated age [1st
15 and 3rd interquartile] was 35 [30;45] years and 87 (48%) were women. One hundred forty
16 three (79%) were wearing surgical mask. The median time of observation was 8 [4;12]
17 minutes. During this period, 87 (48%) persons touched their mask 15 [7.5;30] times per hour
18 of whom only two (8%) have used hydroalcoholic solution to disinfect their hands.

19 **Conclusions:** Mask touching is frequent and is rarely followed by hand disinfection. Actions
20 regarding mask use should be taken to improve compliance.

21

22 **Key words:** Face mask; COVID-19; Face touch; Hand hygiene; Public transportation.

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27 Introduction

28 The World Health Organization (WHO) declared the coronavirus outbreak a pandemic on
29 March 11, 2020 (WHO, 2020). Infection by the SARS-CoV-2 virus, the virus that caused
30 coronavirus disease 2019 (COVID-19), can occur through direct, indirect, or close contact
31 with infected people through infected secretions such as saliva and respiratory secretions or
32 their respiratory droplets (WHO, 2020). This can cause severe illness and may be fatal,
33 especially in vulnerable populations including the elderly or those with medical co-
34 morbidities (Zhu et al., 2020).

35 So far, there are many aspects of the epidemic that are still mysterious, and there are no
36 available effective vaccine or cures to slow SARS-CoV-2 transmission. The standards and
37 transmission-based precautions such as stay-at-home measures, keeping social distance and
38 washing/disinfecting hands using alcohol-based solutions remain crucial to disease mitigation
39 (Jefferson et al., 2011).

40 Even though, health care policy makers' recommendations about generalizing mask usage
41 have varied during the outbreak for several reasons (Feng et al., 2020). New available
42 evidence suggests that the use of facial mask by the general population prevents the overall
43 transmission of SARS-CoV-2 (Leung et al., 2020), (Cheng et al., 2020). After a shortage that
44 lasted for weeks, face masks became progressively available in France for public at beginning
45 of May, 2020. Like most developed countries, French authorities have encouraged the use of
46 facial mask in closed environments such as stores and supermarkets. It became mandatory in
47 public transportation starting of May 11th, 2020 (Légifrance, 2020). Recently, wearing face
48 masks has been made mandatory in all enclosed publics spaces and shops, and more recently
49 in some outdoor public spaces in some towns and cities.

50 Facial masks are considered to be efficient in preventing SARS-CoV-2 spread and to avoid
51 further outbreak. It stops virus transmission through respiratory droplets when an infected
52 wearer coughs or sneezes, and by providing physical barrier between the mouth and nose of
53 the wearer and potential contaminants in the surrounding environment (Liang et al., 2020),
54 (Greenhalgh et al., 2020). Thus, their correct use is of particular importance and incorrectly
55 worn masks may not confer effective protection. There are many types of masks, with
56 differences in the effectiveness in terms of particles filtration. However, this effectiveness
57 might be compromised by the discomfort and the itch related to the use of each type in real
58 life. The WHO states that appropriate use and disposal are essential to ensure that they are

59 effective and to avoid any increase in transmission. It recommends also to clean hands using
60 an alcohol-based hand rub or soap and water after removal or whenever a used mask is
61 inadvertently touched (WHO, 2020). However, as for face-touching, mask-touching may be a
62 spontaneous human behavior making the application of these recommendations challenging.
63 In addition, potential discomfort during usage may also affect compliance.

64 There is no data in the literature on the frequency of mask-touching behavior among users of
65 public transportation. Accordingly, we aimed to describe this behavior in users of public
66 transportation in the greater Paris region.

67 **Methods**

68 Our observational cross-sectional study was conducted in the greater Paris region, France.
69 Data were collected over a period of 3 weeks; between May 4th and 25th, 2020.

70 Public transportation users (subway and local trains) were covertly observed. Five evaluators
71 have been trained and have contributed to collect the data during a total of 30 sessions. A
72 standardized observation sheet was used to collect descriptive characteristics including the
73 following: estimated age, gender, type of mask and if correctly worn, the length of hair,
74 earphones, glasses, beard and the main activity during the ride were also collected. This sheet
75 was also used to tally the frequency of hand-to-mask, to-face and to-hair contacts. The area of
76 the face that was touched (forehead, ear, eyebrow, eye, nose and cheek) as well as the side
77 (right or left) were also specified. The observation time was started by the getting in of the
78 investigator or the observed person in the train or in the subway, and terminated by the
79 getting off of the investigator or the observed person, which happened first. Position of the
80 person, sitting down or standing up, was also recorded. The individuals were also watched for
81 hand application of hydro-alcoholic rub both after mask touching or any surrounding surfaces.
82 No more than two persons were observed simultaneously.

83 Ethical approval was not required as this was an observational study and no confidential data
84 were recorded. The study is reported according to Strengthening the Reporting of
85 Observational Studies in Epidemiology (STROBE) guidelines.

86 **Statistical analysis**

87 The primary outcome was the frequency of facial mask touching. Secondary outcomes were:
88 1) the frequency of touching the uncovered areas of the face, hair and glasses, and 2) the

89 frequency of hand application of hydro-alcoholic rub. Data are described as frequency with
 90 percentages for categorical variables and median [interquartile range] for continuous
 91 variables. Continuous variables were compared using Wilcoxon rank-sum test. χ^2 test of
 92 independence was used to determine whether there is a statistically significant association
 93 between mask touching and categorical variables.. A *p*-value < 0.05 was considered
 94 significant. Statistica 12.0 software (Tulsa, Oklahoma, USA) was used for statistical analysis.

95 **Results**

96 A total of 182 persons were observed with a median of estimated age of 35 [30;45] years. Age
 97 groups distribution is presented in supplemental figure-1. Eighty seven (48%) were females.
 98 Details of demographic and profile of the individuals are presented in table-1. The majority;
 99 143 (79%) were wearing surgical face mask. Fabric and FFP2 masks were observed in 31
 100 (17%) and 2 (1.1%) respectively. The rest were wearing other type of masks. One hundred
 101 seventy one (94%) worn the mask correctly. Nose was uncovered in 7 (3.8%) cases. Nose and
 102 mouth both together were uncovered in 4 (2.2%) cases. Eighty seven (48%) were on their
 103 smartphone, 62 (34%) did not have any activity, 17 (9.3%) were talking on the phone, 9 (5%)
 104 were reading a paper and 7 (3.9%) were talking to another person.

105 The median observation time was 8 [4;12] minutes. The percentages of touching per region
 106 are presented in table-2. During this period of time, 87 (47%) have touched their mask at least
 107 once. Seventy four (41%) have touched at least one time the uncovered area of the face. For
 108 those who touched the external face of their mask, the frequency was of 15 [7.5;30] per hour.
 109 Regarding the touched parts of the face, 15% involved forehead, 8.8% the nose, 7.1% right
 110 side ear, 3.3% right side eyebrow, 6.6% right side eye and 8.2% right side, 3.8% left side ear,
 111 5% left side eyebrow, 4.8% left side eye, and 6% cheek left side. Twenty two persons (12%)
 112 have inserted their hands under the mask and touched this covered part of the face. Twenty
 113 three persons (12%) have touched their hair. The frequency of touching these areas per hour is
 114 presented in figure-1. Moreover, 52 were wearing glasses, of whom 9 (17%) have touched
 115 them.

116 The observed individuals were classified to mask-touching and non-mask-touching groups
 117 and were compared. There was no difference in the duration of observation. The profile of the
 118 two groups was similar except for the observed activities (*p*-value = 0.028 for the Chi-squared
 119 test). The percentage of persons talking on the phone seems to be higher in the mask-touching
 120 group compared with the non-mask-touching group (14.9% and 4.2% respectively). In

121 contrast, the prevalence of persons reading papers seems to be lower in the mask-touching
122 group compared with the non-mask-touching group (1.2% and 8.4 % respectively)
123 (Supplemental table-1),

124 Applying alcohol-based handrub after mask touching was very low. Actually, only 2 persons
125 used this hygiene method after they had touched their mask and only one after he had touched
126 a metal bar.

127 **Discussion**

128 The current study showed that mask-face touching is frequent in the users of public
129 transportation in the greater Paris region. Almost half of the mask wearers have touched their
130 face masks at least one time in a median of time of 8 minutes. The frequency of mask
131 touching was of 15 per hour. Similarly, face touching was frequent too. Hand hygiene was
132 very low in this population.

133 The use of face masks may prevent uncontrolled spread of SARS-CoV-2 in the community
134 and avoid a large resurgence of cases and overwhelming of health-care capacity. This is even
135 more true when reasonable social distance could not be respected e.g. confined spaces with
136 higher population density and less ventilation such as public transportation. There are
137 currently many types of masks available. In our study the most frequent worn mask type was
138 surgical.

139 Upper respiratory tract infections including SARS-CoV-2 may be avoided by not touching the
140 face (Bertsch, 2010). However, and from a physiological point of view, touching face often
141 occurs unintentionally. Itch is sensed by cutaneous nerve fibers called pruriceptors. Sensation
142 of itch and the resulting reaction of scratching play a major role in protection against
143 environmental insults. This may be also have a role in the neuroimmune communication
144 process (Szepietowski et al., 2020). Thus this strategy, though important for infection control
145 purposes, may be counterbalanced by a physiological/behavioral attitude represented by face
146 and mask touching.

147 Furthermore, during mask usage, a variety of sensations and experiences, such as facial
148 pressure, heat, friction or increased skin itchiness may lead to discomfort, thereby affecting
149 compliance (Suen et al., 2020). In a recent study from China, Zuo et al. have documented itch
150 induced by face masks in 15% of healthcare workers (Zuo et al., 2020). In an internet survey
151 conducted in Poland, 20% of mask wearers reported having itch (Szepietowski et al., 2020).

152 Roberge et al. reported facial itch in 7% of the participants of a group of 20 healthy people
153 wearing surgical masks during continuous walking on a treadmill at a low to moderate work
154 rate for 1 hour. An additional 11% experienced skin irritation (Roberge et al., 2012). In
155 another study conducted on 31 clinicians and 48 staff of the Cincinnati Area, Elder et al. have
156 reported 19 times touching the T-zone area (eyes, nose, and mouth) in 2 hours (Elder et al.,
157 2014). In another study, face-touching behavior was observed via videotape recording of 26
158 students. The study reported an average of 23 times per hour with 44% involved contact with
159 a mucous membrane and 56% of contacts involved non-mucosal areas (Kwok et al., 2015).
160 Nicas et al. have conducted a study on videotaped subjects performing office-type work in
161 isolation from other persons during 3 hours. The authors reported an average total contact rate
162 per hour of 15.7 with eyes, nostrils, and lips (Nicas and Best, 2008). The difference in the
163 results between these studies may be explained by the fact that wearing mask in daily life is a
164 common phenomenon in Asian countries. In addition to that, the main activities and settings
165 were different. We have also included touching of the ears. To note, we have observed all
166 touching behaviors including those with no itching (adjustment of the mask, touching or
167 removing to talk on the phone...etc). In our study, persons who were on the phone were those
168 who touched their mask the most. Difficulty in communication and speech intelligibility may
169 explain this result as previously suggested (Suen et al., 2020). In contrast to an old
170 observation (Dimond and Harries, 1984), we did not see any lateralization preference of face
171 touching.

172 Increased tendency to touch the face while wearing a face mask might increase the risk of
173 transmission and self-contamination. Also, use of face masks, avoiding touching the face,
174 nose, eyes and mouth, and hand hygiene should be considered as complementary to other
175 preventive measures that are recommended to reduce transmission of COVID- 19, including
176 physical distancing, staying home when ill, and cleaning and disinfecting frequently touched
177 surfaces. Meanwhile, the potential SARS-CoV-2 infection because of direct contact with a
178 potentially contaminated mask can be mitigated by hand disinfection performed immediately
179 after each touching. Our study, however, revealed low hand hygiene compliance. This might
180 be improved by increasing visibility and accessibility of dispensers and sanitizer location
181 (Cure and Van Enk, 2015).

182 **Limitations of the study**

183 This study has several limitations as we could not have a comparator group with no mask
184 wearers. Persons with dry skin or some facial dermatoses are vulnerable to develop skin
185 reactions to masks resulting in more itching. We could not investigate this point as we didn't
186 had access to medical history of the transport users. A case of allergic contact dermatitis
187 caused by elastic bands from FFP2 masks have been also reported (Navarro-Trivino et al.,
188 2020). Face mask frequently causes discomfort on ear lobe. This may increase touching of
189 this area. We could not confirm this hypothesis as we did not have a comparator group with
190 no mask wearers. The limited number of the non-surgical masks users did not allow us to
191 determine if there is an effect of the type of mask on the frequency of touching. The
192 frequency of itch might vary with the duration of face mask wearing. We could not determine
193 for how long the observed person was wearing his mask. The observations sessions were
194 performed during peak-hours which are known to be concomitant with elevated
195 concentrations of air pollution. We can hypothesize that this might cause more itching and
196 thus higher frequency of mask touching compared to off-peak hours. Other limitations of this
197 study are the small number of individuals observed, the limited observation time, and the
198 human observational error that may bias the results.. The study was performed in subways
199 and trains in Paris area. Thus, the results cannot be generalized without cautions to other
200 populations and other different settings.

201 **Conclusions**

202 The findings of this study demonstrate that the use of face mask is not optimal in the general
203 population. Many individuals touched their mask with a frequency as high as 15 times per
204 hour. Hand hygiene with an alcohol-based hand rub is rarely performed after mask touching.
205 Consequently, further effort should be exerted to improve general public awareness regarding
206 the proper use of face mask. Messages and recommendations regarding face masks use, with
207 avoiding touching them when possible, and hand disinfection, along with barrier measures,
208 should be widely diffused. This could be reached through instruction sheets in public
209 transportation and public areas, broadcast audio messages diffused in the subway and train
210 stations...etc. Other available resources such as media platforms as well as social networks
211 should be used as they might be helpful to communicate with the general population. Other
212 actions such as making hydroalcoholic gel available for sale in train and stations (shops,
213 automatic dispensers) would help in slowing the spread of COVID-19. Our study could be
214 relevant to other settings such as public transports in other cities and countries, but also
215 other crowding conditions such as markets, airports, schools, universities, ...etc. Further large

216 studies in other public transportation systems around the world and other sittings are
217 warranted. Future studies after implementation of the suggested interventions would
218 determine their effectiveness on changing the mask touching behavior and the frequency of
219 hydroalcoholic gel use.

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280

281 **Acknowledgment**

282• **Authorship and contributors:** AG and EM contributed to the study conceptualization and
283 design. AG, ET, AM, CG and HNNC contributed to data collection. AG and EM contributed
284 to data analysis, data interpretation and manuscript preparation. All authors read and approved
285 the final version. AG warrants that the final manuscript and authorships accurately reflect the
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289• **Conflicts of Interest:** The authors declare no conflict of interest for this study.

290

291 **Legends**

292 **Figure-1:** Frequency per hour of touching mask, covered an uncovered area of the face, hair
293 (head), and glasses.

294 **Supplemental Figure-1:** Bar chart showing the estimated age groups of the observed public
295 transportation users.

296

297 **Table-1: General characteristics of the observed individuals.**

Variables	(N=182)
Demographic	
Estimated age, median [Q1;Q3], (years)	35 [30;45]
Men, n (%)	87 (47.8)
Length of hair	
-shaved, n (%)	15 (8.2)
-short, n (%)	86 (47.3)
-semi-long hair, n (%)	48 (26.4)
-long hair, n (%)	21 (11.5)
-covered, n (%)	12 (6.6)
Beard (men)*, n (%)	25 (26.3)
Earphones, n (%)	67 (36.8)
Glasses, n (%)	52 (28.6)
Observations	
Time median [Q1;Q3], (minutes),	8 [4;12]
Transportation mode	
-subway, n (%)	148 (81.3)
-train, n (%)	34 (18.7)
Sitting, (%)	177 (97.3)
Part of the day #	
-morning, n (%)	81 (47.4)
-midday, n (%)	26 (15.2)
-evening, n (%)	64 (37.4)
Mask	Type of mask
	-surgical, n (%)
	143 (78.6)
	-fabric, n (%)
	31 (17)
	-FFP2, n (%)
	2 (1.1)
	-other types, n (%)
	6 (3.3)

Mask position	Correctly worn, n (%)	171 (97)
	Nose exposed, n (%)	7 (3.8)
	Nose and mouth exposed, n (%)	4 (2.2)
 During observation	 Alone, n (%)	 170 (93.4)
	 Main activity	
	<i>-on smart phone, n (%)</i>	87 (47.8)
	<i>-on the phone, n (%)</i>	17 (9.3)
	<i>-reading paper, n (%)</i>	9 (5)
	<i>-talking, n (%)</i>	7 (3.9)
	<i>-nothing, n (%)</i>	62 (34)

298

*on 95 men, # missing data =11

299

Q1: first quartile, Q3: third quartile

300

301 **Table-2: Frequency of touching mask, covered and uncovered area of the face, hair (head),**
 302 **and glasses.**

303

Touched area		
Mask	External face, n (%)	87 (47)
	Frequency/h	15 [7.5;30]
Covered area	(mouth/nose), n (%)	22 (12.1)
	Frequency/h	10 [16;15]
Uncovered area	Total, n (%)	74 (40.6)
	Frequency/h	12 [6.7;20]
Hair (head)	Total, n (%)	23 (12.3)
	Frequency/h	15.0 [7.1;23.3]
Glasses (n=52)	Total, n (%)	9 (17.3)
	Frequency/h	7.5 [6.6;15]

304 **Supplemental Table-1: Comparison between mask-touching and non-mask-touching**
 305 **groups.**

Variables		Mask touching	Non mask touching	p
Estimated age	<i>Median [Q1;Q3], (years)</i>	35 [27;45]	40 [30;45]	0.602
Gender	<i>men, n (%)</i>	48 (55.2)	47 (49.5)	
	<i>women, n (%)</i>	39 (44.8)	48 (50.5)	0.591
Position	<i>sitting, n (%)</i>	85 (97.70)	92 (96.84)	
	<i>standing-up, n (%)</i>	2 (2.30)	3 (3.16)	0.723
Length of hair	<i>shaved, n (%)</i>	6 (6.90)	9 (9.47)	
	<i>short, n (%)</i>	43 (49.43)	43 (45.26)	
	<i>semi-long hair, n (%)</i>	24 (27.59)	24 (25.26)	
	<i>long hair, n (%)</i>	6 (6.90)	15 (15.79)	
	<i>covered, n (%)</i>	8 (9.20)	4 (4.21)	0.244
Beard (men)*	<i>with, n (%)</i>	16 (33.33)	9 (19.15)	
	<i>without, n (%)</i>	32 (66.67)	38 (80.85)	0.116
Earphones	<i>with, n (%)</i>	37 (42.53)	30 (31.58)	
	<i>without, n (%)</i>	50 (57.47)	65 (68.42)	0.126
Glasses	<i>with, n (%)</i>	22 (25.29)	30 (31.58)	
	<i>without, n (%)</i>	65 (74.71)	65 (68.42)	0.348
Type of Mask	<i>surgical, n (%)</i>	67 (77.01)	76 (80.00)	
	<i>tissue, n (%)</i>	14 (16.09)	17 (17.89)	
	<i>fabric, n (%)</i>	3 (3.45)	0 (0)	
	<i>FFP2, n (%)</i>	1 (1.15)	1 (1.05)	
	<i>other types, n (%)</i>	2 (2.30)	1 (1.05)	0.427
Mask position	<i>correctly worn, n (%)</i>	78 (89.66)	93 (97.89)	
	<i>nose exposed, n (%)</i>	6 (6.90)	1 (1.05)	
	<i>nose and mouth exposed, n (%)</i>	3 (3.45)	1 (1.05)	0.062
Main activity	<i>on smart phone, n (%)</i>	41 (47.13)	46 (48.42)	
	<i>on the phone, n (%)</i>	13 (14.94)	4 (4.21)	
	<i>reading paper, n (%)</i>	1 (1.15)	8 (8.42)	16

<i>talking, n (%)</i>	4 (4.60)	3 (3.16)	
<i>nothing, n (%)</i>	28 (32.18)	34 (35.79)	0.028

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307 ***N= 95,**308 **Q1: first quartile, Q3: third quartile**

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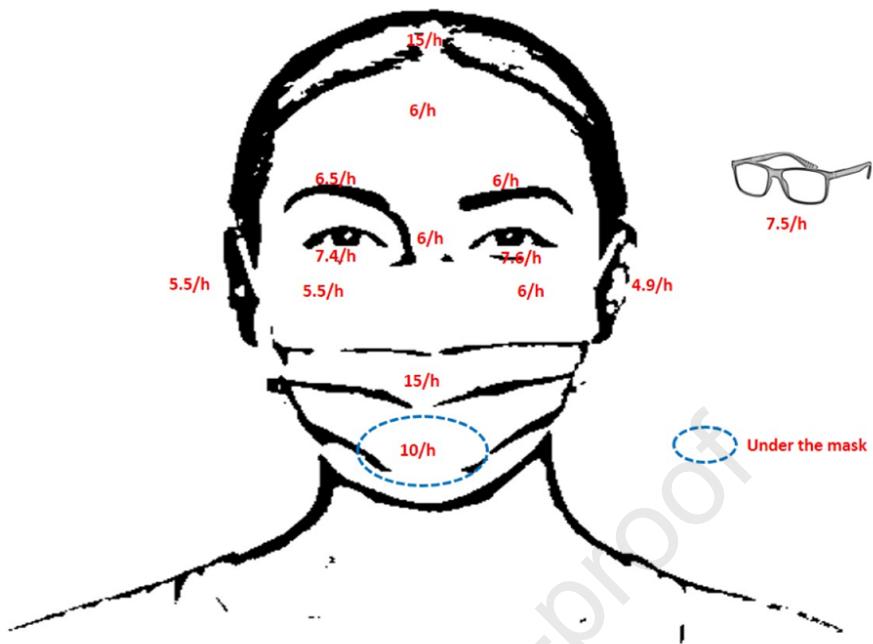


Figure-1

Highlights

- The use of facial mask by the general population might prevent the overall transmission of SARS-CoV-2.
- The WHO recommends the use of face masks as part of the pandemic control strategy. It advises to avoid touching them.
- Face touching is a common behavior. However, there is no data on the frequency of mask touching.
- Our study shows that mask touching is frequent in the general population and it is rarely followed by application of alcohol-based handrub.
- Further effort should be taken to improve public transportation users' awareness regarding the proper use of face masks.

Author statement

AG and EM contributed to the study conceptualization and design. AG, ET, AM, CG and HNNC contributed to data collection. AG and EM contributed to data analysis, data interpretation and manuscript preparation. All authors read and approved the final version. AG warrants that the final manuscript and authorships accurately reflect the contributions of all individuals who participated substantially in the study.

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